

Robinson (F.B.)

Automatic Menstrual Ganglia.
A New Theory of Men-
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BY

F. B. ROBINSON, B. S., M. D.,

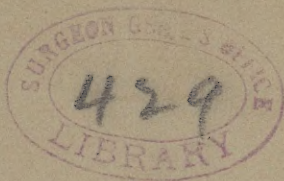
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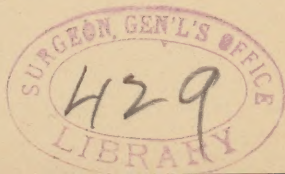
A NEW THEORY OF MENSTRUATION.

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9 For several years I have been investigating the relation of the tubes, uterus, and ovaries in menstruation. By a visit to Berlin in 1884 I was enabled to examine a very large number of tubes, uteri, and ovaries in Professor Virchow's laboratory. In 1887, in a trip to Vienna, I was able to examine many more in Professor Kundrat's laboratory. Since then I have been carefully investigating the relation of the tubes, ovaries, and uteri of the lower animals. I examined about a hundred and fifty tubes, ovaries, and uteri of sows which were freshly butchered and in all states of existence. The number of various conditions which these organs were found in was remarkable. The ovaries of sows which are supposed to be healthy vary in size from that of a plum-stone to that of a large bunch of grapes. The main disease was shown by cystic conditions of the Graafian follicles. The Graafian follicles *generally* grew in crops of from three to ten and showed cystic enlargement or cystic degeneration. The maturation and



rupture of the Graafian follicles go in definite cycles and definite periods of time. One sees wandering follicles jutting out on the ovary now and then and here and there, but they look like fruit picked before its time. The normal ova mature and rupture by crops, by cycles, by a periodic rhythm. The tubes of the sow show a plainer state of cycle or rhythm. Seldom is the tube found uncongested. It has its intermenstrual periodic peristaltic motion. By the varied condition of the congestion of the tube, one can see that it has a very marked cycle of movement. Its activity is greatest at the time of menstruation and its walls are dark-blue and crimson with injected blood. At the climax of the congestion, when the Graafian vesicle is almost ready to burst, and particularly for a few days following, the fimbria is enormously enlarged and spread over the ripened ova like an umbrella. I have found sometimes slight adhesions between the broadened, congested fimbria and the bursting follicle. Then, as the ovary shrank and lost its congested blood, so the tube gradually shrank to its normal size to begin a new cycle of motion. The marked organ in the whole process is the tube at its fimbriated extremity. Menstruation might be called the motion of the tubes. An observation which I noted was that the tubes did not respond to every ripening crop of eggs in the ovary alike. I have seen large ova projecting high above the ovarian surface, but the tubes were still and uncongested. The ova had degenerated and the tube did not go through its rhythmical cycle, its peristaltic motion. The muscular part of the fimbria which is attached to the ovary induces some tubal motion by its periodic contraction and relaxation. The only rational physiological explanation of the approach of the tube on the ovary at distinct times is that the muscle which connects the fimbriated extremity of the tube to the ovary contracts. No reasonable explanation can be given

of the view that the ovary moves toward the tube. The careful examination of some fifty cows and thirty-five sheep showed similar conditions but not so marked.

The view brought forth in this article is that menstruation is governed by the ganglia situated in the uterine walls and along the tubes and closely connected with the ovaries; that tubal motion constitutes the cycle of the menstrual period due to ganglia. The question may be asked, What is a nervous ganglion? A nervous ganglion is a collection of nerve-cells. Its constituents are nerve-cells and nerve-fibers. It is an ideal nervous center having a central, conducting, and peripheral apparatus. A ganglion is a little brain, a physiological center. It has the power of receiving sensation and transmitting motion. It is automatic in itself. It possesses the power of nourishment and controls secretions. Reflex action can be demonstrated in it. What we call sensory, motor, and sympathetic nerve-fibers are found making up its construction. The great peculiarity of a ganglion is its cyclical movements, its rhythmic action. Its function is periodic, continually rising to a maximum or sinking to a minimum. Its mode of living is to go through cycles, epochs, periods, and eras as bodies complete their circles round the sun. The ganglion may act abruptly and explode, as in the heart-beat, or gently rise and fall, as in respiration.

Histologists have long known that in the abdominal viscera there exist ganglia possessed of automatic powers. The names of Remak, Bidder, Ludwig, Schmidt, and others are associated with the discovery and description of these visceral ganglia. I have satisfied myself many a time, in vivisection on dogs and other animals, that the heart has automatic nervous centers or ganglia, which will continue its action independently of its cerebro-spinal connection; not only that it has automatic nerve ganglia in its walls, but

that nearly all these ganglia are centered in the walls of the auricle. We know by experiment that the heart will perform its cycle of contraction independently of its external nervous connection. Many times I have watched the heart's action gradually die out from apex to base. Hence, few doubt that the ganglia of Ludwig, Bidder, Remak, and Schmidt govern the heart in the style called automatic.

Experiments on dogs' intestines prove that their walls possess automatic ganglia. I have seen the intestines of a dog keep up their peristaltic motion long after death, and, on tapping the intestines with the scalpel over an hour after death, the bowel walls would take on a vermicular motion. Many times I have watched with wonder this "invagination of death" for an hour after I had chloroformed the dog to death. Now, Auerbach demonstrated long ago that this cyclical motion could go on independently of the great nervous center, that intestinal peristalsis was due to many small ganglia situated on a network of nerves located between the circular and the longitudinal muscular layers of the gut-wall. This nervous plexus with its ganglia is called Auerbach's. It is set in motion by an appropriate stimulus, and will perform its peculiar cycle or rhythm. Just under the mucous membrane of the intestine is found another nerve plexus with its connected numerous ganglia, designated as Meissner's plexus. This, no doubt, has to do with secretion, and, when stimulated by appropriate forces, will go through a circle of action.

The same statements can be made relative to the bladder. It is supplied by two kinds of nerves. One kind is the sympathetic nerves, which go to its summit and body and are studded over with small ganglia. These ganglia are closely associated with the blood-vessels and muscles in its walls, and have an influence in controlling the periodic rhythm and cyclical movements of the bladder. As an ex-

ample of the actions of the ganglia of automatic motion in the bladder, I took from the body of a stag, weighing fourteen hundred pounds, the bladder, penis, and rectum. In some twelve hours after, it contracted down quite small, at which time I dilated it. Thirty-six hours after, I examined it again, and I found that it had contracted smaller than ever, showing a cavity which would contain about half a pint of fluid. These sympathetic ganglia of the bladder had presented automatic action and rhythm for at least forty hours. The matter can be best demonstrated by injecting its blood-vessels with fluid and then watching it hourly for a day, and the slow cyclical rhythm can be plainly seen. If one wishes to see the demonstration in a more obvious and striking manner, the best way is to choose the uterus of a large cow that has borne calves, which will have long, tortuous, helicoid arteries. These long blood-channels will be endowed with many ganglia. Now, by injecting colored fluid into this big uterus one can easily observe the varying periodic, cyclical rhythm of the different portions and sections of the uterus for some forty hours after death and the detachment of the uterus from the cow. The other kind of nerves supplying the base and neck of the bladder are the sacral, spinal, and they endow that part of the bladder with sensation, while the summit of the bladder, being supplied by sympathetic ganglia, has only blunt sensation; but the summit and the body of the bladder are the parts endowed with ganglia, and also the parts endowed with the cyclical rhythm, while the base and neck, supplied with but few ganglia and a large supply of sacral spinal nerves, do not enter very largely into the rhythmic action.

The uterus and appendages are no exception to the condition of other abdominal viscera. It has been known for some time that on the nerves supplying the uterine wall of

animals there existed many of these similar ganglia. The ganglia extend along the oviducts.

It is also demonstrated that nerve ganglia of the same kind exist in the walls of woman's uterus. Histologists and microscopists found and described these ganglia some time ago. These ganglia are found especially in the muscularis mucosæ, and, according to Lindgren, there exists a nerve plexus also in the mucous membrane of the uterus. Hence, here we have the same condition as is well known to exist in the walls of the heart (auricles) and the walls of the intestines and also of the bladder. It is simply the old automaton—a plexus of nerves studded over with numerous ganglia—that induces the uterus and tubes to perform their rhythmic cycle. There is also, no doubt, some vital connection between a uterine and tubal cycle and an ovarian cycle. In other words, there is close communion between menstruation and the maturation of a *normal* ovum. I have observed in the sow that sometimes when the crop of ova did not mature normally, the tube at its fimbriated extremity did not go through its wonted cycle. It was still and pale. The degenerated ova did not excite the ganglia in the uterus and tubes to make their cyclical rhythm. These three organs—uterus, tubes, and ovaries—must come into conjunction to perform their normal action, which is to get an egg into the uterus. It may be compared to the heavenly bodies whirling around the sun; many revolutions will be made by any two before they make an eclipse or come in conjunction with the sun so that the two bodies and the sun stand in a straight line. The bodies will pass each other dozens of times and make no shadow, but there comes a time when the three bodies will stand in a straight line and a shadow will be cast. So it is with the tubes, uterus, and ovaries; there comes a time when the three stand in such a relation to each other that a normal egg

gets into the uterus—it passes from a ruptured Graafian follicle into a prepared (congested) transporting canal, and is floated into a prepared soil and rests on the inside of the uterus, the endometrium. No doubt the turgid, congested state of the organs induces rupture of the Graafian follicle. It may be that the ganglionic nervous plexus of the ovary can act through its rhythm at a different time and period than the tube and uterus; that the excitement starting the ganglia governing the ovarian cycle is not associated closely with the ganglia governing the cycle of the tube and uterus.

That menstruation is governed by a nervous ganglionic plexus is also confirmed by the very remarkable researches of Dr. Arthur Johnstone, of Danville, Ky., who asserts that the uterine lining membrane is not a mucous membrane, but a gland—a substance known as adenoid tissue; and also Dr. Johnstone has demonstrated that a nerve plexus located along the uterus and tubes has a large share in influencing the rhythm of menstruation, and that there is one especially large nerve trunk which, being cut, quite effectually aids in arresting menstruation. I have been able to confirm the views of Dr. Johnstone that there is adenoid tissue in the endometrium. The method I used was to watch for a very clear day, especially when a rain had washed the dust out of the atmosphere, and then to use an Abbé's lighting apparatus, a high ocular, and a Reichert's homogeneous oil-immersion of very high power. The adenoid tissue under such circumstances is generally visible. Professor Tait adds confirmatory evidence to this theory. The question may arise, If the endometrium is a gland, and menstruation is governed by the ganglia connected with it and the tubes, why does not menstruation go on from birth to death? We may say that the endometric gland is only functionally active at a definite period of life, and hence the nerve gan-

glia in it only normally work at the same period. This is not a strange matter. The thymus gland is the largest at birth. The thyreoid gland becomes most active in youth, say in girls at fifteen. It is a common observation that the sebaceous glands of the face of males become very active at a distinct period and grow coarse, stout hair. No doubt the gland existed long before the beard grew. The sebaceous glands on females grow a beard often late in life—after menstrual cessation. Glands act at definite periods of life. A good example is the salivary gland, which does not secrete until some months after birth. That menstruation has close relation with the nervous system, and that too with the sympathetic as it gives rhythm, is a common observation; nervous disturbance disturbs menstruation. I knew a country schoolma'm who was menstruating and walking to her school-house on a railroad track. Suddenly the train came up behind her from a curve and whistled. The affair so frightened her that she immediately ceased menstruating, and did not menstruate for about a year.

When the nervous system is impaired in strength by wasting disease there may not be enough vital energy to induce and carry on menstruation. All have observed how tubercular girls stop menstruating. It is a common observation that fat persons have weak resisting power against disease, and very fat girls often do not menstruate. Again, with a precocious, abnormally developed, nervous girl one may see early menstruation. In pregnancy and nursing menstruation is arrested, because the nervous vitality is expended in nourishment. The fat girl, the tubercular girl, and the pregnant or nursing woman, do not menstruate, because the vital nervous energy either is drifted into other channels or is insufficient to start the ganglia and keep them going through a menstrual rhythm. A cold reduces

vital nerve power and checks the menstrual flow. Our observations on the lower animals seemed to indicate that the most active explosion of nervous energy must occur in the ganglia associated with the fimbriated end of the tube. The most apparent phenomenon in menstruation that strikes the eye is the vast movement and congestion occurring in the fimbriated part of the tube. The amount of congestion, change, and motion in this part of the tube is enormous. The movements executed by the tubes have not heretofore received marked attention, but tubal motion will receive more attention in the future. The tubes execute vast cycles of motion and seem to be going through a peculiar rhythm continually—of congestion, motion, and decongestion. We may yet come to say that a girl has arrived at the period of tubal motion instead of puberty; that the climax of woman is simply the cessation of tubal motion. The irritation of the ganglia governing the tubal cycle induces the fimbria to approach the ovary by shortening the muscular strip which connects the ovary and tube, and thus it drops its umbrella-like fringe over the ovary and secures, if possible, the egg in its funnel. Whether menstruation of woman and the rut of animals are one and the same thing, time and investigation must decide. Whether menstruation, in the progress of evolution, is an addition of civilization and also a reward of the upright posture of man, time must tell. It would seem a nasty and defective civilization that would add this fruitful source of physical and mental suffering to the highest animal. Yet evolution works toward death as well as toward life. When man got on his hind feet he advanced wonderfully in his dexterity and lost wonderfully in the power of his heart and circulation.

Later researches tend to show that ovulation and menstruation are wholly independent of each other. However,

all agree that they can be concurrent, that the ovum, tube, and uterus can reach a climax at the same time, and the egg is floated on to the endometrium by the fluids secured by excessive congestion. A dry, contracted, uncongested tube could not readily transport or float an ovum. Many of my microscopic specimens and dozens of observations on man and animals convince me that ovulation is a constant process from before birth until some time after the climax—until the ovarian germinal tissue gives out. It is common to find in calves at birth ovarian follicles as large as beans and ready to burst. Histologists tell us that a female child is born with over fifty thousand ova in her ovaries. Of course, she can not have menstrual periods to dispose of these at say one to three ovulations at each period. But I would call attention to the idea that ovulation at rut or menstrual epochs appears to differ from ovulation at other epochs, as before puberty. The ovulation at other times than at rut or menstruation may not produce normal ova or ova which will develop. It requires a normally developed gland—the endometrium with its properly matured *ganglia*, the tubes with their matured nerve plexus and *ganglia*—to act in concert with a matured ovary to secure a normal egg which can be fecundated. Other kind of ovulation is simply blighted fruit. The more I study the subject, the more I am convinced that the tubes play a very high rôle in menstruation, and that their movement (congestion and decongestion) is governed by ganglia which endow them with a rhythm. The gland known as the endometrium acts in harmony with the tubes, but the tubal motion overshadows all the rest in menstruation. The time required by these various visceral ganglia to complete a rhythmical cycle varies with varying influences. The ganglia of Bidder, Schmidt, Ludwig, and Remak in the heart explode and complete their rhythm in less than a second. The respira-

tory rhythm is completed in some four seconds. The intestinal rhythm, or peristalsis, presided over by Auerbach's and Meissner's plexuses with their *ganglia*, have varying cycles, according to the varying stimuli applied.

The ganglia in the uterus and tubes of woman induce a cycle generally once a month. They explode monthly. In the lower animals these automatic uterine and tubal ganglia explode in periods which are equal to the cycle of the rut. Therefore menstruation and rut are governed in their rhythmic cycle by the automatic uterine and tubal ganglia. Will these views lend any aid in explaining the action or function of uterus, tubes, or ovary after surgical or other destructive procedures on any one of the three? It appears to me they will. Under the views presented in this paper it would not be expected that ablation of the ovaries would cause menstruation to cease suddenly. The automatic ganglia of the tubes and uterus are still intact, and will execute their rhythm. Most gynecologists give evidence that this agrees with facts. Ovaries are extirpated and tubal motion continues. However, the destruction of part of a connected complex organ soon destroys the nice balance, and nourishment of the ganglia would in time deteriorate, and then insufficient nervous vitality would fail in starting and sustaining a menstrual rhythm. Again, extirpation of the tubes, according to these views, would quite effectually aid in arresting menstruation and tubal motion, though not entirely, as many ganglia would be left in the uterine wall. But in the very plan of the machinery the tube is no doubt designed to execute a larger range of motion than the uterus. The tube, to secure an egg, is forced to considerable motion, while the uterus could perform its function by being relatively still. Hence most of the automatic ganglia governing menstruation or tubal motion are in relation with the oviducts. This view also agrees with facts. Most of

the gynæcologists whom I saw operating in the German clinics told me that removal of the tubes in the vast majority of cases finally checked menstruation. Professor Lawson Tait writes that total removal of the tubes causes menstruation to cease in ninety per cent. of cases. Actual cases also prove to us that when only the ovaries are removed in women, with inflammation existing in the other uterine appendages, they are but little helped in their misery until the tubes are removed, for the active organ in menstruation is the tube. Finally, the most of the uterus and tubes being extirpated, the menses would in nearly all cases cease, because almost every automatic menstrual ganglion would be removed with the uterus and tube. The ovary left intact without a tube or uterus would do no harm, as its blighted ova would be absorbed, degenerate, or fall into the peritonæum. In those cases where menstruation continues after extirpation of tubes and uterus, no doubt some menstrual automatic ganglia were left undestroyed.

I hope to be able to continue further microscopic investigation on these ganglia, which I shall term the *automatic menstrual ganglia*. To me the various action of the heart under varying state and pressure of the blood is not so intelligible without a knowledge that the automatic ganglia situated in its walls control and regulate its movements. The pressure and the state of the blood act as a stimulus to excite the heart to normal action through its automatic cardiac ganglia. A knowledge of the functions of these automatic cardiac ganglia clears up many an obscure problem and renders more intelligible the action of the heart under varying circumstances. So it suggests itself to me that a knowledge of what I shall term automatic menstrual ganglia will throw more light on the action of that organ around which woman is built both physically and mentally. I hope these ganglia will render the functions

of the uterus, but especially the tubes, more obvious, and aid in clearing obscure pathological action.

The theory of ganglionic regulation of menstruation—that is, the initiation and execution of a menstrual cycle by nervous ganglionic centers located along the great highways of nutrition (the blood-vessels) and in the substance of the uterus and *tubes*—is, so far as I know, a new one. This view of the matter came to me from several years of observation in large slaughter houses, and still more forcibly from the wonderful manifestations seen in the peculiar movements of the heart and intestines by a goodly number of vivisections on dogs. If any man will watch for a single half-hour the “invagination of death” on a dog a half-hour after the dog’s death, knowledge will occur to him which no book can convey. Considerable microscopic work has aided in completing the theory, as well as clinical observation. A very suggestive sample may be given as to the valuable observations one can acquire in a slaughter house. It also confirmed my view of the extensive existence of uterine and tubal automatic nervous ganglia. In fact, such samples were the key-note of comparison.

Dr. C. S. Miller and myself were watching the slaughter and evisceration of a cow weighing some fifteen hundred pounds. The cow was in the eighth month of pregnancy. When the butcher was taking the body of the uterus away he amputated it at the internal os. This left a stump of uterus about six inches long and three inches thick. Our attention was immediately called to the action of this stump. Long after the death of the cow we observed its peculiar cyclical action. The stump slowly described circles and arcs with diameters varying from an inch to nearly four inches. All the muscular layers of that thick uterus worked in perfect harmony. No uterine layer of muscles interfered with any other. Every part of the uterine stump seemed to

work with intelligence or a kind of a *quasi* judgment. At one time the circular muscular layer would go through a slow but distinct cycle of action before any other would begin. Then gradually the longitudinal layers of muscles would begin to act and the end of the uterine stump would describe a circle of action, and so it kept repeating these circles, cycles, and contractions until we left, nearly an hour after. It may be said that the action of the muscular layers of the uterus was very vigorous. Each and every visceral organ has its own supply of the sympathetic ganglia brought to it on the walls of the blood-vessels. So each and every visceral organ requiring it has its own established cycle, initiated in primordial life and strengthened by repetition and higher differentiation of special organs, and a more extensive nerve supply (ganglia) to the organs through the inscrutable changes that the evolution of ages adds.

Another point which adds strength to the theory of automatic menstrual ganglia is the following: All anatomists agree that the uterine sympathetic plexus is given off just above where the sacral spinal nerves join it. Now, spinal nerves probably have very little to do with cyclical action (perhaps hinder it). Therefore the sympathetic with its ganglia goes to the body and fundus of the uterus and tubes, which are enabled to go through their cycle of action (menstruation) with but slight trammeling or inhibiting action of the sacral spinal nerves. While the large supply of sacral spinal nerves which go to the cervix and vagina prohibits any cyclical action of those parts in menstruation, the excessive supply of sacral spinal nerves to the cervix and vagina forces the fewer sympathetic ganglia to live sober and steady lives, lest they hold the parts in *tension constantly* as the nervous system holds the muscles during life. Hence the excessive supply of the sacral spinal nerves to the cervix and their

force hold such power as to allow no waxing or waning from foreign ganglia; but the body of the uterus and the tubes, having an excess of sympathetic ganglia over sacral spinal nerves, go through with their cycles. It is also noted that the ganglia follow the blood courses, and the upper part of the uterus has an enormous supply of blood brought to it by helicoid vessels—blood-vessels much too long for a uterus in the non-gravid state, and so the vessels lie in coils like angle-worms or ropes. This increases the space for ganglia. According to this theory, the cervix and vagina will be less involved in menstrual cycles than the body and fundus of the uterus and the tubes. Few will doubt that this agrees with facts. Again, these automatic menstrual ganglia are situated not only in the substance of the uterus and tubes, but notably along the walls of the blood-vessels. From this arises an important matter relative to nutrition, or, in other words, blood-supply to the tubes and uterus. As the ganglia wax and wane, so the blood-vessels wax and wane. The blood-supply is thus regulated. As the ganglia approach their maximum of function the blood-vessel assumes its maximum of dilatation. Minimal ganglionic action decides vascular contraction.

The influence of these automatic ganglia on the gestating uterus is occasionally marked, so that it is manifestly shown in slow, but certain, progressive nutritive changes. The changes may go on with or without a method—mostly with a method. I know personally of a pregnant woman who was present at the perforation of a little girl's ear-lobes preparatory to inserting ornamental objects in her ears. The pregnant woman saw the girl's ears pierced, and when her baby was born the baby's ear-lobes were actually perforated by distinct holes, all ready for her womanly vanity, without the pain of acquisition. This influence was, no doubt, produced slowly, through the changes of nutrition,

by ganglionic centers lying on the blood-vessel wall of the uterus. I know another woman who, while pregnant, stepped on a frog, and she continually would revert, while thinking, to that frog, with his ugly *warts*, and when her child was born the toes on one foot were merely warts. The force of nervous influence on the organs of woman is seen in those cases where the physical stimulus, as in marriage, or the mental stimulus, as in the *expectation* of marriage, will actually regulate the automatic menstrual ganglia into bringing about healthy, normal periods of menstruation.



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